

Utilization of Swamp Forages from South Kalimantan on Local Goat Performances

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ABSTRACT

Forages in swamp area consist of grass and legumes that have good productivity and nutrient quality. This research was aimed to evaluate the potency of swamp forage on digestibility and performance of goats. There were 24 local male goats aged 10-12 months with initial body weight of 13.10 ± 1.55 kg, allocated into 6 treatments. Those were control (R0): 60% grass and 40% legumes; (R1): 60% swamp forages and 40% concentrate; (R2): 100% swamp forages; (R3): 100% swamp forage hay; (R4): 100% swamp forage silage; (R5): 100% haylage swamp forages. Results showed that silage treatment significantly increased ($P < 0.05$) consumption and digestibility. Swamp forages could be utilized well by preservation (silage, hay, and haylage). Ensilage of swamp forages increased protein content from 13.72% to 14.02%, protein intake (74.62 g/d), dry matter intake (532.11 g/d), nitrogen free extract intake (257.39 g/d), with total body weight gain (3.5 kg) in eight weeks and average daily gain (62.60 g/d). It is concluded that ensilage of swamp forages (R4) is very potential to be utilized as forage source for ruminants such as goats.

Key words: body weight, goat, haylage, silage, swamp forage

ABSTRAK

Hijauan yang tumbuh di rawa terdiri atas rumput dan leguminosae yang memiliki produktivitas dan kandungan nutrisi yang cukup baik. Penelitian ini bertujuan untuk mengevaluasi potensi penggunaan hijauan rawa sebagai pakan ternak ditinjau dari pencernaan dan performa ternak kambing. Sebanyak 24 ekor kambing kacang jantan umur 10-12 bulan dengan bobot badan awal $13,10 \pm 1,55$ kg digunakan dalam penelitian dan dibagi menjadi 6 kelompok perlakuan. Perlakuan penelitian terdiri atas kontrol (R0): 60% rumput dan 40% leguminosa, (R1): 60% hijauan rawa dan 40% konsentrat, (R2): 100% hijauan rawa segar, (R3): 100% hay hijauan rawa, (R4): 100% silase hijauan rawa, (R5): 100% haylage hijauan rawa. Hasil penelitian menunjukkan bahwa hijauan rawa yang diawetkan dengan metode silase mampu meningkatkan ($P < 0,05$) konsumsi dan pencernaan pakan. Pengawetan dengan metode silase mampu meningkatkan protein kasar dari 13,72% menjadi 14,02%, menghasilkan nilai konsumsi protein sebesar 74,62 g/hari, konsumsi bahan kering sebesar 532,11 g/ekor/hari, dan konsumsi BET-N sebesar 257,39 g/ekor/hari, serta mampu meningkatkan bobot badan total (3,5 kg) dalam delapan minggu dengan pertambahan berat badan harian (62,60 g/hari/ekor). Disimpulkan bahwa silase hijauan rawa (60% rumput rawa dan 40% legum rawa) berpotensi untuk digunakan sebagai pengganti hijauan (R4) bagi ternak kambing.

Kata kunci: bobot badan, haylage, hijauan rawa, kambing, silase

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INTRODUCTION

Forage feed is necessary, either quantitatively or qualitatively, in ruminant production systems (Fernandes, 2007). Ruminants mostly consume forage but its availability in quantity and quality is limited. Swamp forage, containing grass (mainly Kumpai Batu and Kumpai Minyak) and legumes (mainly Beberasan and Pipisangan), grow well in swamp area and potential as feed source for Kalang buffalo, cattle, and goats.

South Kalimantan has a swamp land area of 210,489 ha, potential for the development of agriculture, fisheries and livestock, because it is supported by the availability of vast land, flat topography and abundant water (Mariana, 2011). Swamp land keeps potential fodder for animal husbandry, mainly ruminant feed. The swamp forage has high productivity and nutrients and can be used for animal feed (Fariani & Eviyati, 2008).

Swamp forage in the South Kalimantan has 18 types of forage consisted of *Oryza rufipogon*, *Hymenachne amplexicaulis*, *Ipomea* sp, *Altenanthera sesilis*, *Ludwigia adscendens* (L. H. Hara, *Ipomea aquatica* and other. However, some forages are dominant with high production and quality of nutrients, namely Kumpai Batu, Kumpai Minyak, Beberasan and Pipisangan. Grass variety and production found in the area were Kumpai Batu (*Ishaemum polystachyum* J. Press), 9.45 ton/ha/season, Kumpai Minyak (*Hymenachne amplexicalis* (Rudge) Nees), 11.3 ton/ha/season; Pipisangan (*Jussiea linifolia* Vahl), 9.144 ton/ha/season; and Beberasan (*Persicaria barbata* (L) H. Hara), 9.5 ton/ha/season. However, the potency of this swamp forage is not enough to cover the need of forage during dry season (Rostini *et al.*, 2014).

Nutrients composition of Kumpai Minyak (*H. amplexicaulis* (Rudge) Nees) showed 10.88% crude protein (CP), 16.37% crude fiber (CF), 62.6% neutral detergent fiber (NDF) 36.75%. Kumpai Batu (*Ishaemum Polystachyum* J. Press) had 14.36% CP, 17.35% CF, 40.38% NDF, and 39.26% ADF. Pipisangan revealed 15.96% CP, 25.23% CF, 24.48% NDF, 23.83% ADF. Beberasan (*Persicaria barbata* (L) H. Hara) had 16.45% CP, 18.27% CF, 56.42% NDF, and 51.62% ADF (Rostini *et al.*, 2014).

Utilization of swamp forage mainly for Kalang buffalos that are reared in the area based on the seasons, rainy or dry seasons. The use of swamp forage by other ruminants such as goats was not as much as for buffalos. Goats are a potential producer of small ruminants in Indonesia (Budisatria *et al.*, 2010). Goats are able to consume feed with high CF and low CP better than sheep (Alcaida *et al.*, 2003). The objectives of the research were to evaluate the utilization of swamp forage in the goat rations and its effect on digestibility and performance of goats.

MATERIALS AND METHODS

This research was conducted from December 2012 until July 2013 in several places, at animal housing facilities of the Faculty of Agricultural, Islamic University of Muhammad Arsyad Albanjary, Kalimantan (*in vivo*

and preservation of swamp forage), Feed Technology Laboratory, Faculty of Animal Science, Bogor Agricultural University (digestibility trial) and Research Center for Bioresource and Biotechnology Laboratory of Feed Analysis (Proximate analysis).

The swamp forages on the 40th d (*I. polystachyum* J. Press, *H. amplexicalis* (Rudge) Nees, *P. barbata* (L) H. Hara, and *J. linifolia* Vahl) were collected from the swamp area in Labuan Amas, Hulu Sungai Tengah district and Danau Panggang, Hulu Sungai Selatan district. Molasses was supplied from PT Indofeed Bogor; bacteria *L. plantarum* was obtained from Biotechnology Laboratory, Indonesian Institute of Sciences (LIPI) and rice bran was supplied from rice huller in Hulu Sungai Tengah district. Anthelmintic drug was provided by Kalbezen (Kalbe Farma). Nutrient compositions of the swamp forages are presented in Table 1 and Table 2, respectively.

Twenty four local male goats aged 10–12 mo, weighed 13.10±1.55 kg were used in this experiment, and were kept in individual 1 m x 1.5 m cages. Feeding

Table 1. Nutrient composition of the swamp forage used in preservation (dry matter base)

Nutrient (%)	<i>H. amplexicalis</i> (Rudge) Nees	<i>I. polystachyum</i> J. Press	<i>J. linifolia</i> Vahl	<i>P. barbata</i> (L) H. Hara
Protein	10.88	14.36	15.96	16.45
Ether extract	1.20	1.29	0.85	0.61
Crude fiber	16.37	17.35	25.23	16.27
Neutral detergent fiber	62.60	40.38	24.48	56.42
Acid detergent fiber	36.75	39.26	23.83	51.62
Hemicellulose	26.00	1.12	40.65	4.80
Cellulose	33.95	25.77	20.07	34.03
Lignin	2.65	13.49	3.76	17.59
Tannin	2.46	3.74	17.26	4.07
Calcium (Ca)	0.29	0.29	1.05	0.85
Phosphorus (P)	0.12	0.13	0.14	0.18
WSC	4.21	4.71	6.55	2.85

Table 2. Nutrient composition of the swamp forage in silage, hay, and haylage (dry matter base)

Nutrien (%)	Fresh forage	Silage	Hay	Haylage
Crude protein	13.72	14.02	13.52	14.25
Crude fiber	21.16	13.89	16.11	14.52
Ether extract	8.14	8.13	4.66	7.79
Nitrogen free extract	52.97	48.36	50.79	49.08
Neutral detergent fiber	56.17	51.86	54.9	53.01
Acid detergent fiber	47.33	33.75	35.11	34.54
Calcium (Ca)	0.72	0.70	0.70	0.70
Phosphorus (P)	0.17	0.17	0.17	0.17

treatments were (R0): 60% native grass and 40% native legumes; (R1): 60% swamp forage (60% swamp grass and 40% swamp legumes) and 40% concentrate; (R2): 100% swamp forage (60% swamp grass and 40% swamp legumes); (R3): 100% swamp forage (60% swamp grass and 40% swamp legumes) hay; (R4): 100% swamp forage (60% swamp grass and 40% swamp legumes) silage; (R5): 100% haylage swamp forage (60% swamp grass and 40% swamp legumes). Composition and nutrient content of each diet are presented in Table 3.

Diets were given 3.5% DM of goat body weight. Diets were served at 08.00 and 15.00 daily, were weighed each morning and drinking water was provided *ad libitum*. Body weight was measured weekly in the morning before feeding and drinking water, using Salter scale (50±0.1 kg capacity). Parameters measured were feed intake, nutrient digestibility, average daily gain (ADG) and feed efficiency (FE)

Feces Collection

Collecting of feces was done for seven days at the end of 8th week of experimental period. During the experiment, each goat was kept in an individual metabolic cage. Feces was collected using fine wire strainer put under each cage and weighed daily in the morning. Daily 10% of samples were taken and composited in a plastic bag and kept in a refrigerator for further analysis.

Chemical and Statistical Analysis

Feed samples, and feces were oven dried in 60 °C for 48 h, ground using Willey grinder with 1.0 mm strainer then samples were put in plastic bag and kept for analysis. Analyses of dry matter, ash, crude protein, ether extract, crude fiber, and tannin were conducted according to procedures of AOAC (2003). Data were analyzed for variance and any significant difference was detected using Duncan Multiple Range Test (DMRT) according to Steel & Torrie (1993).

RESULTS AND DISCUSSION

Nutrient Intakes

Preservation of swamp forage showed the significant effect ($P<0.05$) on nutrient intakes (Table 4). This suggested that the swamp forage palatability improved with senilage, with softer texture than the fresh form. Goetsch *et al.* (2010) stated that feed intake was influenced by the shape and physical properties of the feed, and chemical composition of the feed. Ensilage has been proven to improve the quality of the physical properties and forage legumes (Baubaker *et al.*, 2006).

Dry matter intake (DMI) according to NRC (2007) for goats with 10-20 kg of body weight was 200-480 g/d; which was 1.9%-5.5% lower than those found in this study. The DMI in other studies was around 434–560 g/d (Suparjo *et al.*, 2011), while the DMI in the present

Table 3. Composition and nutrient content of diets for each treatment

Composition (%)	R0	R1	R2	R3	R4	R5
Field grass	60	0	0	0	0	0
Mixed legume	40	0	0	0	0	0
Rice husk	0	40	0	0	0	0
<i>H. amplexiacalis</i> (Rudge) Nees	0	29.51	39.51	0	0	0
<i>I. polystachyum</i> J. Press	0	10.49	20.44	0	0	0
<i>J. linifolia</i> Vahl	0	8.84	18.83	0	0	0
<i>P. barbata</i> (L) H. Hara	0	11.16	21.16	0	0	0
Silage – swamp forage	0	0	0	0	100	0
Hay - swamp forage	0	0	0	100	0	0
Haylage- swamp forage	0	0	0	0	0	100
Nutrient (%)						
Crude protein	12.10	12.73	13.72	13.52	14.02	14.25
Ether extract	6.11	9.23	5.94	2.66	8.13	7.79
Ash	6.37	6.03	6.21	6.23	6.87	7.31
Crude fiber	21.23	19.87	21.16	16.11	13.81	14.52
Nitrogen free extract (NFE)	48.24	43.69	43.74	53.79	48.36	49.08
TDN	62.33	62.52	58.98	60.07	64.43	65.09
Neutral detergent fiber (NDF)	65.44	66.14	68.17	54.86	51.9	53.01
Acid detergent fiber (ADF)	39.87	37.26	32.35	35.11	33.75	34.54

Note: R0= 60% grass + 40% leguminose; R1= 60% swamp forage + 40% concentrate; R2= 100% swamp forage; R3= 100% swamp forage hay; R4= 100% swamp forage silage; R5= 100% haylage swamp forage.

Table 4. Nutrient intakes of goats fed preserved swamp forage

Intakes (g/d)	R0	R1	R2	R3	R4	R5
Dry matter	535.41±14 ^b	549.98±28.0 ^b	422.45±21.0 ^a	410.12±12.0 ^a	532.11±11.0 ^b	465.72±22.0 ^a
Crude protein	64.78±1.6 ^b	70.01±4.0 ^c	57.96±5.0 ^a	55.44±2.0 ^a	74.62±6.0 ^c	66.36±8.0 ^b
Crude fiber	119.06±2.6 ^b	114.25±5.4 ^b	94.68±7.8 ^b	70.17±2.5 ^a	76.96±9.2 ^a	71.25±13.0 ^a
Ether extract	34.24±5.0 ^b	53.07±7.0 ^c	26.58±3.0 ^b	19.58±3.0 ^a	45.30±3.0 ^c	38.23±4.0 ^{bc}
Nitrogen free extract (NFE)	258.47±8.0 ^c	240.28±16.0 ^{bc}	184.77±25.0 ^a	256.30±17.0 ^c	257.39±28.0 ^c	228.58±34.0 ^b
Neutral detergent fiber (NDF)	320.62±17.0 ^c	342.75±19.0 ^c	287.67±12.0 ^b	266.16±16.0 ^a	276.05±26.0 ^b	246.87±37.0 ^a
Acid detergent fiber (ADF)	192.05±14.0 ^c	204.92±16.0 ^c	136.66±13.0 ^a	137.19±22.0 ^a	179.96±16.0 ^b	160.85±24.0 ^b

Note: Means in the same row or within column with different superscript differ significantly ($P<0.05$). R0= 60% grass + 40% leguminose; R1= 60% swamp forage + 40% concentrate; R2= 100% swamp forage; R3= 100% swamp forage hay; R4= 100% swamp forage silage; R5= 100% haylage swamp forage.

study was around 410.12–549.49 g/d. The DMI of R1 was the highest ($P<0.05$) compared to (Table 4) R3- hay. However, the average of DMI from legume (R0), with concentrate (R1), and with swamp forage silage (R4) were significantly higher ($P<0.05$) than those of fresh swamp forage (R2), hay (R3), and haylage (R5). These mean that diet containing legume or concentrate in combination with swamp forage as well as swamp forage silage was more palatable than the others. Santoso & Hariadi (2008) reported that forage silage was more palatable due to a softer texture. Aregheore (2006), feed intake is influenced by the physical properties and nutrient composition of feed.

Protein intake of diet containing combination of concentrate and swamp forage silage was significantly higher ($P<0.05$) than those of R2, R3, and R5 (Table 4). Protein intake ranged from 55.51–74.62 g/d, which was comparable to the standard of protein intake by NRC that was around 56–58 g/d (NRC, 2007) for goats with body weight 13–15 kg. Protein intake is crucial for optimum production (in this case daily weight gain) and reproduction. Sunarso (2012) stated that protein required for maintenance depends on diet type, protein quality, energy level and animal's condition. These results were confirmed by the data of DM digestibility (Table 5); that R0, R1, R4 and R5 were significantly higher ($P<0.05$) than R2 and R3. Degradability rate might affect digestibility and intake of dry matter (Lewis & Emmans, 2010).

Fiber intake of haylage (R5) was significantly ($P<0.05$) lower than that of 60% grass + 40% leguminose local diet (R0). This difference was due to their different textures affected by preservation that eventually decreased fiber contents and increased palatability of the diets (Table 3). Total intake of diet was affected by some factors such as feed ingredients composition as well as its texture (Van Soest, 2002). Goats require fiber for activity and normal rumen function. Fiber is degraded by microbes to yield energy for maintenance, growth, reproduction, and lactation (Lu *et al.*, 2005).

Intake of nitrogen free extract (NFE) in this study was about 184.77–258.47 g/d and statistically ($P<0.05$) different among treatments; with R3 (hay) was the lowest and R4 (silage) being the highest. Low level of NFE indicated low levels of dry matter and protein but high in fiber. The NFE content gives a rough idea of the amount of carbohydrate and sugar of feed ingredients (Alcaida *et al.*, 2003).

Nutrient Digestibility of Swamp Forage

The digestibility of silage swamp forage treatment (R4) was a little higher than fresh swamp forage (R2) but not significantly different ($P>0.05$) compared with the R1 treatment (forage + concentrate). Swamp forage in the form of hay (R3) did not differ from haylage (R5) or fresh swamp forage (R2). However, these results

Table 5. Nutrient digestibility of diet containing swamp forage in goats

Digestibility (%)	R0	R1	R2	R3	R4	R5
Dry matter	77.2± 4.7 ^b	75.9± 3.4 ^b	65.7±11.3 ^a	67.3± 2.8 ^a	74.5±10.3 ^b	69.2±10.4 ^b
Crude protein	70.4± 3.2 ^b	67.9± 2.8 ^b	64.6± 2.1 ^a	65.3±11.2 ^a	68.4±11.2 ^b	66.2± 2.6 ^a
Crude fiber	72.6± 0.3 ^b	68.3± 1.3 ^a	65.2± 2.2 ^a	67.7± 2.5 ^a	70.6± 1.2 ^b	69.4± 3.6 ^{ab}
Ether extract	65.7± 5.6 ^a	75.5±10.2 ^b	63.6± 5.7 ^a	65.7±10.3 ^a	74.3± 7.3 ^b	72.4± 4.3 ^b
Nitrogen free extract (NFE)	68.6±12.5 ^{ab}	73.4± 6.4 ^b	63.2±11.4 ^a	64.3± 2.8 ^a	70.2± 7.5 ^b	67.1± 2.8 ^{ab}
Neutral detergent fiber (NDF)	74.5± 4.7 ^b	75.3± 1.3 ^b	62.8± 4.9 ^a	60.6± 2.5 ^a	64.6± 3.2 ^a	62.4± 3.6 ^a
Acid detergent fiber (ADF)	75.8± 6.6 ^c	70.9± 1.8 ^b	58.2± 2.2 ^a	62.6± 2.5 ^a	66.8± 4.2 ^b	64.4± 3.6 ^b

Note: Means in the same row or within column with different superscript differ significantly ($P<0.05$). R0= 60% grass + 40% leguminose; R1= 60% swamp forage + 40% concentrate; R2= 100% swamp forage; R3= 100% swamp forage hay; R4= 100% swamp forage silage; R5= 100% haylage swamp forage.

were not much different from the research reported by Wirawan *et al.* (2012) that the digestibility of dry matter of goats fed native grass was 64.6%-68.5%.

The higher dry matter digestibility of ration with (R4) was caused by higher feed consumption and higher protein content (14.02%) but lower in lignin. Setianah *et al.* (2004) stated that the increase of ration protein will increase and stimulate the development rate and population of rumen microbes so that the dry matter digestion will be higher. Suparjo *et al.* (2011) reported that digestibility of goats fed fermented ration had higher dry matter digestibility than that those fed unfermented ration. This was the effect of the changes of the feed that was more fermentable leading to the increase of fiber digestion. Van *et al.* (2005) stated that fermented feed with *L. plantarum* was able to lower lignin and increased protein. The reduced lignin content increasing the microbes ability to degrade cellulose, hemicellulose and other components. Van_Hao & Linden (2001) described that to increase digestibility of ration, needs to do physical and biological treatments to make it more palatable.

Digestibility of crude protein in this study ranged from 64.6%-70.4%. Digestibility of crude protein was similar to the digestibility of dry matter, where the diet R3 treatment significantly ($P<0.05$) lower than other treatments. The decrease in protein digestibility is closely related to dry matter intake and feed intake of protein, where the protein content of fresh swamp forage was lower than other treatments.

NFE digestibility of this study was 63.2%-73.4% and significantly different ($P<0.05$). NFE digestibility is influenced by the composition of the feed, livestock species, age and feed composition ratio (Tillman *et al.*, 1998). Digestibility of NFE differ between treatments, the highest in the treatment of R1 at 73.5% while the lowest was 63.2% in the R2. Different NFE digestibility in feed treatments because there is differences on source of starch concentrates McDonald *et al.* (2002) stated that the different sources of carbohydrate in the diet will affect the NFE digestibility.

Digestibility of crude fiber in this study was 65.7%-72.6% (Tabel 5) and statistically different ($P<0.05$) among treatments. Goats fed silage and haylage had higher digestibility by 8.8% and 3.5% respectively, compared to those given fresh forage, hay (R3). The results of this study were much higher than goats fed native grass

with average digestibility of 66.9% (Wirawan *et al.*, 2012) whereas goats fed fermented rice straw had average digestibility 63.2% (Novita *et al.*, 2006). This is due to the fermentation process loosen fibers bond lignin and hemicellulose, making them easier to be digested. Digestibility of lignin can be increased after treatment (fermentation), as the materials that undergo fermentation processes become more soluble so that the digestibility of cell wall becomes faster. Table 5 showed that the ration digestibility of silage and haylage (R4 and R5) was better than other treatments. This is most likely due to the higher protein content and lignin content due to cell wall degradation during the bioprocess. Toharmat *et al.* (2006) reported that digestibility of fiber fractions in goats fed fermented diet were 57.85% and 51.15% for the digestibility of NDF and ADF, respectively. NDF digestibility became an important parameter in predicting the quality of feed ingredients (Iyayi *et al.*, 2004). Luo *et al.* (2004) reported digestibility of fiber fractions in goats was 70.0% NDF, 60.0% ADF and 71.3% cellulose.

Average Daily Gain and Feed Efficiency of Goats Fed Swamp Forage

Goats fed silage swamp forage (R4) produced the heaviest live weight ($P>0.05$), compared with control. The low ADG of R2 treatment-related to protein, TDN and low digestibility and allegedly less balanced absorbed nutrients or due to high lignin in the forage. Rubanza *et al.* (2003) reported that the network of plant cell wall lignin compounds bound carbohydrates (cellulose and hemicellulose) into complex compounds that are not easily digested by animals and therefore could not provide an optimal body weight gain. Tarigan & Ginting (2011) reported that the body weight gain of goats fed the passion fruit peel silage showed daily gain of 64.9 g/d while those given fresh fruit skin the daily gain was 41.6 g/ d.

Average daily gain (ADG) or growth is an indicator of nutrient deposition process in the body. Growth is defined as the change in the scale and shape as well as an increase in body mass livestock (Mulligan *et al.*, 2001).

Daily gain of goats fed silage swamp forage (R4) was significantly higher compared with those fed fresh forage (R0) and fresh swamp forage (R2) but not significantly different with forage plus concentrate (R1). This is in line with the consumption of dry matter and digest-

Table 6. Body weight gain and feed efficiency of goats fed swamp forage for 8 weeks

Variable	R0	R1	R2	R3	R4	R5
Initial body weight (kg)	12.97±1.2	13.10±1.1	13.05±1.1	13.37±1.1	13.37±1.1	13.27±1.2
Final body weight (kg)	15.72±0.5 ^{ab}	15.63±0.4 ^a	15.15±0.6 ^a	15.40±0.4 ^a	17.00±0.6 ^c	16.00±0.6 ^b
Weight gain (kg)	2.75±1.1 ^b	2.52±1.2 ^a	2.10±1.3 ^a	2.20±1.2 ^a	3.50±0.3 ^c	2.75±0.6 ^b
Average daily gain (g/d)	49.10±5.5 ^b	45.08±2.2 ^b	37.49±6.8 ^a	40.79±3.3 ^a	62.60±1.4 ^c	51.80±4.5 ^b
Feed efficiency (FE)	0.09±0.01	0.08±0.01	0.08±0.02	0.11±0.01	0.12±0.003	0.11±0.01

Note: Means in the same row or within column with different superscript differ significantly ($P<0.05$). R0= 60% grass + 40% leguminose; R1= 60% swamp forage + 40% concentrate; R2= 100% swamp forage; R3= 100% swamp forage hay; R4= 100% swamp forage silage; R5= 100% haylage swamp forage.

ibility of fresh swamp forage. This is similar to the Limea *et al.* (2009) who stated that the form of animal feed influenced the performance of animals. If the quality of animal feed consumed is better, the body weight gain will be higher. Toharmat *et al.* (2006) stated that the type of feed can affect dry matter intake and consumption of other nutrients which in turn will affect the performance of livestock.

Feed efficiency (FE) indicates the amount of body weight gain produced from 1 kg of feed. Swamp forage feed efficiency are presented in Table 6. The highest efficiency of feed utilization showed in goats fed silage (R4). This showed that forage preserved in the form of silage was more efficient than the fresh swamp forage swamp (R2) and in dry form (R3). This may be related to the amount of the absorbed nutrients or nutrient content in the feed. Fedele *et al.* (2002) stated that feed was efficient if it was consumed in small amounts but able to produce high body weight gain.

CONCLUSION

Preserving swamp forages into silage produces the highest digestibility, the highest weight gain, and the best feed efficiency. Swamp forage silage is potential to be used as a substitute for any local forages for goats.

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